Special and General Relativity and the Relativistic Ether as observer dependent by the Retardation

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Abstract

In this paper I'll show how the relativistic effect in SRT must be observer dependent which is leading to field and retardation, and that is leading to the wave-particle duality and the uncertainty principle by the vacuum fluctuation. In this I propose a new transformation by translating the retardation according to the invariance by the entanglement which is leading to the relativistic ether from the point of view of the quantum vacuum which is leading to the wave-particle duality and the uncertainty principle by the vacuum fluctuation. According to my transformation, there two pictures for the moving train, and these two pictures are separate in space and time as a result of the retardation but they are entangled by the invariance of the energy momentum. That will lead also to explain the double slit experiment from the point of view of quantum theory. In my new transformation, I propose there is no space-time continuum, as in special relativity; it is only time, and space is invariant. That leads to the new transformation being vacuum energy dependent instead of relative velocity dependent as in Einstein's interpretation of the Lorentz transformation equations of the theory of special relativity. Furthermore, the Lorentz factor in my transformation is equivalent to the refractive index in optics. That leads to the disappearance of all the paradoxes of the theory of special relativity: The Twin paradox, Ehrenfest paradox, the Ladder paradox, and Bell's spaceship paradox. Furthermore, according to my interpretation, one could explain the experimental results of quantum tunneling and entanglement (spooky action), Casimir effect, and Hartman effect. Also according to that by my equivalence principle, dark matter and dark energy are explained, and no need to propose dark matter and dark energy, and as a consequence of that, the cosmological constant problem will be solved.

Kay words: Special relativity, General relativity, relativistic ether, retardation, vacuum fluctuation, wave-particle duality, uncertainty principle, Entanglement.

Theory

In my paper [1], I have reached to my new transformation

$$x = \gamma^2 (x' - vt')$$
$$t = \gamma^2 \left(t' - \frac{vx'}{c^2}\right)$$
$$y = \gamma y'$$
$$z = \gamma z'$$

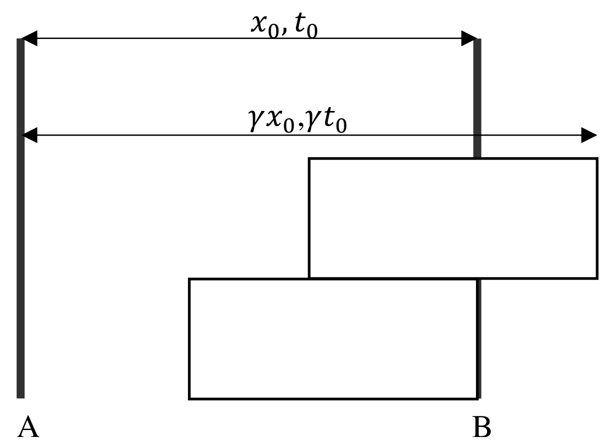

Figure 1: illustrates the location of the moving train during the motion for the observer stationary on the ground according to his time ground clock reading t, and the location of the moving train for the observer stationary on the moving train according to his time clock reading t' stationary on moving train.

My transformation expresses about the clock retardation according to the invariance of the energy momentum by the entanglement. That will lead to the wave-particle duality and the uncertainty principle by the vacuum fluctuation [1-6].

In my transformation space is invariant, and that means there is no length contraction as proposed by Lorentz transformation in order to keep on the reality is observer independent according to the Minkowski space-time. As Minkowski said about his work in relativity, ***"The views of space and time which I wish to lay before you have sprung from the soil of experimental physics, and therein lies their strength. They are radical. Henceforth space by itself, and time by itself, are doomed to fade away into mere shadows, and only a kind of union of the two will preserve an independent reality*** [18]***."*** And we find that will lead to a great problem in physics specially when we are trying to reach to the unified theory.

According to my transformation we get the relativistic ether from the point of view of quantum vacuum which is quantum field theory, and this relativistic ether is observer dependent. Engelhardt [9] obtained the dispersion relation according to Maxwell's ether theory of light by Galilean transformation according the phase velocity. What I found in my paper, if we translated the retardation according to the invariance by the entanglement by considering space is invariant, in this case we get a vacuum fluctuation as a result of the wave-particle duality and the uncertainty, and according to that we get the relativistic ether as observer dependent from the point of view of the quantum vacuum and the vacuum fluctuation. In this case we get the speed of light must be constant in the local classical vacuum, and globally the speed of light is not constant by fluctuate. And that will lead to Doppler effect for photons is the consequence of the energy and momentum exchange between the atom and the photon: a central role is played by the quantum energy jump ΔE of the transition (a relativistic invariant) same as showed by Schrodinger in 1922 [7], and the same we can explain the aberration.

Now according to my transformation when the moving train at constant speed v arrives pylon B as in Fig. (1) for the observer stationary on the moving train, in this case we get for the observer stationary on the moving train

$$t' = t_0 \qquad (1)$$

and

$$x' = x_0 \qquad (2)$$

For the observer stationary on the ground, at this momentum, the front of the moving train passed pylon B and the moving train is at distance from pylon A

$$x = \gamma x_0 = \gamma x' \qquad (3)$$

$$t = \gamma t_0 = \gamma t' \qquad (4)$$

In this case we get that the term $\frac{vx\prime}{c^2}$ will be equal to zero. Here in my transformation x and x' represent the light path for the two observers, the observer stationary on the ground and the observer stationary on the moving train.

Here L is the length of the moving train which is invariant for the both the two observers on the ground and the observer stationary on the moving. In my theory space is invariant. That means both the two observers will agree at the length of the moving train to be L during the motion same as if the train is stationary.

In this case when an object inside the moving train leaves the boundaries of his moving train to the ground, this case there must be a vacuum fluctuation by the wave-particle duality and the uncertainty as a result of the retardation, and thus in this case the clock of the object is reading time t' as a result of the retardation, and that will be explained in more details in my equivalence principle. In this case we get

$$t' = \gamma^{-1} t \qquad (5)$$

and in this case when the object leaves the boundaries of the moving train to the ground, in this case there must be a vacuum fluctuation, and when we make a localization at this moment, the object will be at distance on the ground from pylon A

$$x' = \gamma x_0 = \gamma L \qquad (6)$$

not at a distance $x' = x_0$ because at this moment, the object left the boundaries space of the moving train to the space of the ground. My transformation illustrates the theory of Feynman and how time is moving forward not backward. In this case for the object for itself, the object is transformation from a distance on the ground at $x' = x_0$ to a distance $x' = \gamma x_0$ in a zero-time separation.

Now by considering the length of the moving train is invariant for both the two observers stationary on the ground and stationary on the moving train, in this case we get for the observer stationary on the moving train, the speed of light is c locally where in this case we have according to his clock locally

$$c'_{ob-train} = \frac{L}{t'} = \frac{L}{t_0} = \frac{x_0}{t_0} = c \qquad (7)$$

According to that we get according to my transformation that ***"the light speed is constant in the local classical vacuum".***

For the observer stationary on the ground there are two velocities are measured for the light beam globally when it leaves the space of the moving train, the phase and group, which are measured globally as a result of the retardation as

$$c'_{ob-ground-phase} = \frac{L}{t} = \gamma^{-1}\frac{L}{t'} = \gamma^{-1}\frac{L}{t_0} = \gamma^{-1}c \qquad (8)$$

And the group velocity as a result of the vacuum fluctuation, and in this case the uncertainty principle pays the rule as a result of the retardation, in this case we get

$$c'_{ob-ground-group} = \gamma^{-2}c \qquad (9)$$

That's how the speed of light globally according to my transformation is not constant by fluctuate!

THE RELATIVISTIC ENERGY-MOMENTUM

The relativistic kinetic energy of the moving train relative to an observer stationary on ground is given according to the equation

$$\mathrm{E_k} = \frac{\mathrm{E_0}}{\sqrt{1 - \frac{\mathrm{v^2}}{\mathrm{c^2}}}} - \mathrm{E_0}, \qquad (10)$$

$\mathrm{E_0} = \mathrm{m_0 c^2}$ and $\mathrm{E_k}$ is the relativistic kinetic energy.
Now by solving this equation in terms of v, we get

,

$$v = \sqrt{\frac{E_k^2 + 2E_kE_0}{(E_k \quad + E_0)^2}}\, c \qquad (11)$$

When $E_k \ll E_0$ we get the classical kinetic energy $E_k = \frac{1}{2}m_0v^2$

According to Eq. (11) there is no way for the moving train to reach to the speed of light locally on ground.

The relativistic momentum of the moving train relative to the observer stationary on the ground is given according to the equation

$$P = \frac{m_0 v}{\sqrt{1 - \frac{v^2}{c^2}}} \qquad (12)$$

Now substitute the value of v from Eq. (11) in Eq.(12), we get

$$\frac{P^2c^2}{E_k + 2m_0c^2} = E_k \qquad (13)$$

Now when $m_0 = 0$ we get

$$P = \frac{h\nu}{c}$$

Now if we substitute from Eq. (10) the value of $E_k = \frac{E_0}{\sqrt{1-\frac{v^2}{c^2}}} - E_0$ in Eq. (13), we get

$$E^2 = P^2c^2 + (m_0c^2)^2 \qquad (14)$$

And from that we get

$$P^2c^2 = E^2 - (m_0c^2)^2$$

Where

$$E = \frac{E_0}{\sqrt{1 - \frac{v^2}{c^2}}}$$

Now we have here the relativistic momentum of the moving train relative to the observer stationary on the ground is

$$P_{\text{train-for ground observer}} = \frac{m_0 v}{\sqrt{1 - \frac{v^2}{c^2}}}$$

which leading to Eq. (13). While the classical momentum of the moving train for itself according to the definition of the proper time in special relativity which is leading to the retardation in my transformation is given as

$$P_{\text{train-for itself}} = m_0 v$$

where the momentum of the moving train for itself is the classical momentum, m_0 is the rest mass of the moving train. Here we proposed the self-momentum of the moving train in order to get the retardation which is proven experimentally which is translated in my transformation.

Now by the reciprocity we find the momentum of the observer stationary on the ground relative to the observer stationary on the moving train

$$P_{\text{ground}-\text{train by the reciprocity}} = m_0 v$$

which is the classical momentum by the reciprocity, where here m_0 is the rest mass of the observer stationary on the ground. That illustrates the relationship between my transformation and the Galilean transformation, where in this case my transformation will lead to the Copenhagen school by translating the retardation according to the invariance by the entanglement which is leading to the wave-particle duality and the uncertainty principle by the vacuum fluctuation. That explains how *in classical mechanics, a special status is assigned to time in the sense that it is treated as a classical background parameter, external to the system itself. This special role is seen in the standard formulation of quantum mechanics. It is regarded as part of an a priori given classical background with a well defined value. In fact, the classical treatment of time is deeply intertwined with the Copenhagen interpretation of quantum mechanics, and, thus, with the conceptual foundations of quantum theory: all measurements of observables are made at certain instants of time and probabilities are only assigned to such measurements* [19].

According to that we could solve the problem of time [19] according to my transformation. Where in my transformation, the Lorentz factor by translating the retardation according to invariance by the entanglement is leading to the probability in QM where $0 \leq \gamma^{-1} \leq 1$.

THE EQUIVALENCE PRINCIPLE AND THE RELATIVISTIC ESCAPE VELOCITY

According to my transformation by translating the retardation according to the invariance by the entanglement, we find that the moving train is accelerated or decelerated according to the radiation exchange. That's how *in quantum mechanics, the analogue of Newton's law is Schrödinger's equation for a quantum system (usually atoms, molecules, and subatomic particles whether free, bound, or localized). It is not an algebraic equation, but in general a linear partial differential equation, describing the time-evolution of the system's wave function (also called a "state function").* According to that we can reach to real equivalence principle as the in the following.

Suppose now the train is at rest, and after that the velocity of the moving train is changed from zero to v to move with kinetic energy E_k locally on the ground relative to an observer stationary on the ground. According to my equivalence principle as a result changing the velocity of the moving train from 0 to v with kinetic energy E_k , the velocity of stationary rider inside moving train must be changed also from 0 to v locally on the moving train as a result of inertia. Let's see how that will happen according to my equivalence principle. According to my transformation as a result of retardation we get when the clock inside the moving train reads locally inside the moving train t_0 for the observer stationary on the moving train, at this momentum for the observer stationary on the ground his clock reads t where in this case we get from Eq. (4) according to the retardation

$$t = \gamma t_0$$

This equation illustrates that the moving train is delayed for the observer stationary inside the moving train in space and time on ground comparing to where the train is now on the ground for the observer stationary on the ground according to his space and time as illustrated in Fig. (1). According to my transformation, there are two pictures for the moving train, and these two pictures are separated in space and time but entangled with each other's by the invariance of the energy momentum.

From Eq. (4) for the light beam inside the moving train relative to an observer stationary on the ground we get the frequency of the light beam must be changed as a result of the retardation comparing to the same light beam if it was transmitted on the classical space of the ground relative to the earth observer, where in this case we get for the observer on ground, the measured frequency of the light beam as a result of the retardation will be

$$\nu = \gamma^{-1}\nu_0$$

And from that the energy of the photon will be different relative to the observer stationary on the ground as a result of the retardation, where

$$h\nu_0' = \gamma^{-1}h\nu_0$$

And from that we get

$$E_0' = \gamma^{-1}E_0 \qquad (15)$$

From that as a result of the wave-particle duality, we can compare the rest mass energy of the stationary observer inside the moving train relative to reference frame of the observer stationary on the ground to get

$$E_0' = \gamma^{-1}m_0c^2 \qquad (16)$$

where from that we get

$$\Delta E = E_0 - E_0' = E_0(1 - \gamma^{-1}) \qquad (17)$$

This difference of energy must represent the relativistic kinetic energy of the rest rider inside the moving train as a result of inertia let the velocity of the rider changes from 0 to v locally on the moving train as a result the velocity of the moving train changes from 0 to v locally on the ground.

Now substitute in Eq. (11) according to the invariance of the energy momentum $E_k = \Delta E$ and instead of E_0 we have now from Eq. (16) $E_0' = \gamma^{-1}E_0$ then we get

$$V' = \sqrt{\frac{(\Delta E)^2 + 2\Delta E E'_0}{(\Delta E + E'_0)^2}}\ \mathrm{c} \qquad (18)$$

Now substitute from Eq. (17) $\Delta\mathrm{E} = \mathrm{E}_0 - \mathrm{E}'_0$ in Eq. (18), we get

$$V' = \sqrt{\frac{(E_0 - E'_0)^2 + 2(E_0 - E'_0)E'_0}{(E_0 - E'_0 + E'_0)^2}}\ c$$

$$V' = \sqrt{\frac{E_0^2 - 2E_0E'_0 + E'^2_0 + 2E_0E'_0 - 2E'^2_0}{E_0^2}}\ c$$

$$V' = \sqrt{\frac{E_0^2 - E'^2_0}{E_0^2}}\ c \qquad (19)$$

$$V' = \sqrt{1 - \frac{E'^2_0}{E_0^2}}\ c$$

Now substitute from Eq. (16) $E'_0 = \gamma^{-1}E_0$ in Eq. (19). We get

$$V' = \sqrt{1 - \frac{(\gamma^{-1}E_0)^2}{E_0^2}}\ c$$

Thus we get

$$V' = \sqrt{1 - \gamma^{-2}}\ c \qquad (20)$$

Now if we substitute in Eq. (20)

$$\gamma^{-2} = 1 - \frac{\mathrm{v}^2}{c^2}$$

We get $V' = \mathrm{v}$, where according to that when the velocity of the moving train changes 0 to v with relativistic kinetic energy E_k locally on the ground, in this case the velocity of the stationary rider on the moving train will change also from 0 to v locally on the moving train according to the invariance of the energy momentum.

Now from Eqs. (17)&(20), we can derive the relativistic escape velocity as in the following. If we consider the relativistic kinetic energy in Eq. (17) equals to the gravitational potential, where

$$\Delta E = \frac{GMm_0}{r}$$

And

$$E_0 = m_0c^2$$

in this case we get

$$\frac{GMm_0}{r} = m_0c^2(1 - \gamma^{-1})$$

And from that we get

$$\gamma^{-1} = \left(1 - \frac{GM}{c^2 r}\right) \qquad (21)$$

Now substitute from Eq. (21) in Eq. (20), we get the relativistic escape velocity locally of the free fall object under the gravitational field. In this case we get

$$V_{escape-locally} = \sqrt{\frac{2GM}{r} - \frac{G^2M^2}{c^2r^2}}$$

Now globally we have two velocities can be measured, the first velocity is the phase velocity, where in this case the phase velocity of the free fall object globally is given as

$$V_{escape-phase-globally} = \left(1 - \frac{GM}{c^2 r}\right)\sqrt{\frac{2GM}{r} - \frac{G^2M^2}{c^2r^2}} \qquad (22)$$

And when we make a localization, in this case we get globally as the motion in linear dispersion and this case we get the group velocity and phase velocity are equal, and in this case the group velocity is given same as in Eq. (22). Now during the free fall, we have here a vacuum fluctuation, which is equivalent to motion in nonlinear dispersion, and in this case the uncertainty principle plays the rule, where in this case even if we start with a fairly localized “particle”, it will soon loose this localization. According to that the group velocity is not equal to the phase in case of nonlinear dispersion, and in this case the group velocity is given according to my transformation as

$$V_{escape-group-globally} = (1 - \frac{GM}{c^2 r})^2\sqrt{\frac{2GM}{r} - \frac{G^2M^2}{c^2r^2}} \qquad (23)$$

Now at strong gravitational field at the gravitational radius $\alpha = GM/c^2$, we get locally $V_{escape-locally} = c$. Now globally we get by the Lorentz factor the escape velocity must be zero, which is equivalent to the probability of exactly zero that the object can leave the gravitational radius at $\alpha = GM/c^2$. But in quantum mechanics as a result of the treatment of matter in quantum mechanics as having properties of waves and particles. One interpretation of this duality involves the Heisenberg uncertainty principle, which defines a limit on how precisely the position and the momentum of a particle can be known at the same time. This implies that there are no solutions with a probability of exactly zero (or one), though a solution may approach infinity if, for example, the calculation for its position was taken as a probability of 1, the other, i.e. its speed, would have to be infinity. Hence, the probability of a given particle's existence on the opposite side of an intervening barrier is non-zero, and such particles will appear on the 'other' (a semantically difficult word in this instance) side with a relative frequency proportional to this probability.

The Precession of Mercury’s Perihelion

Kepler’s law can be defined as

$$dA = \int_0^R dr(rd\theta) = \int_0^R rdrd\theta = \frac{R^2}{2} d\theta \qquad (24)$$

The Kepler's second law is defined as

$$\frac{dA}{dt} = \frac{R^2}{2}\frac{d\theta}{dt} = constant \qquad (25)$$

Now we can compute the relativistic Mercury precession according to my transformation and my equivalence principle as in the following.

when we make a localization according to my transformation and my equivalence principle, we get the phase velocity and the group velocity are equal globally which are given according to Eq. (22), and in this case, we get as a result of the retardation from Eq. (6)

$$dr' = \frac{dr}{(1 - \frac{GM}{c^2 r})} \qquad (26)$$

From Eq. (26) and from Kepler's law we get the area element by the distortion is given as

$$dA' = \int_0^R dr'(rd\theta) = \int_0^R \frac{r\ dr\ d\theta}{(1 - \frac{GM}{c^2 r})}$$

Thus by doing the integration by considering $\alpha = \frac{GM}{c^2}$ we get

$$dA' = \left[\tfrac{1}{2} R^2 + \alpha R + \alpha^2 \ln \frac{|R - \alpha|}{\alpha} \right] d\theta$$

In the equation above we find that there is a singularity for the case when $R = \alpha$ which is not the usual singularity at Schwarzschild radius $2GM/c^2$but at gravitational radius GM/c^2. Now in case of weak gravitational field we get

$$dA' = \frac{R^2}{2}\left(1 + \frac{2GM}{c^2 R}\right) d\theta \qquad (27)$$

Equation (27) represents the relativistic form in case of weak gravitational field of the element of area. The classical form is given from Eq. (24)

$$dA = \frac{R^2}{2} d\theta = \int_0^R dr(rd\theta)$$

From my transformation from Eq. (5) according to the retardation and by my equivalence principle from Eq. (21), we get

$$dt' = \left(1 - \frac{GM}{c^2R}\right) dt \qquad (28)$$

Thus by dividing eq. (27) by dt' we get

$$\frac{dA'}{dt'} = \frac{R^2}{2}\left(1 + \frac{2GM}{c^2R}\right)\frac{d\theta}{dt'}$$

By substituting from eq. (28), we get in case of weak gravitational field where $GM/c^2R \ll 1$, in this case we get

$$\frac{dA'}{dt'} = \frac{R^2}{2}\left(1 + \frac{2GM}{c^2R}\right)\left(1 + \frac{GM}{c^2R}\right)\frac{d\theta}{dt}$$

$$\frac{dA'}{dt'} = \frac{R^2}{2}\left(1 + \frac{GM}{c^2R} + \frac{2GM}{c^2R} + \frac{2G^2M^2}{c^4R^2}\right)\frac{d\theta}{dt}$$

$$\frac{dA'}{dt'} = \frac{R^2}{2}\left(1 + \frac{3GM}{c^2R} + \frac{2G^2M^2}{c^4R^2}\right)\frac{d\theta}{dt}$$

And since in case of weak gravitational field

$$\frac{2G^2M^2}{c^4R^2} \ll \frac{3GM}{c^2R}$$

In this case we get

$$\frac{dA'}{dt'} = \frac{R^2}{2}\left(1 + \frac{3GM}{c^2R}\right)\frac{d\theta}{dt}$$

Comparing the classical form of Kepler's second law from Eq. (25)

$$\frac{dA}{dt} = \frac{R^2}{2}\frac{d\theta}{dt}$$

We can conclude from the relativistic form that

$$d\theta' = \left(1 + \frac{3GM}{c^2R}\right) d\theta \qquad (29)$$

By considering

$$R = \frac{a(1 - \varepsilon^2)}{1 - \varepsilon\, cos\theta}$$

And by substituting the value of R in eq. (29) we get

$$\Delta\theta' = \int_0^{2\pi} d\theta + \frac{3GM}{c^2 a(a-\varepsilon^2)} \int_0^{2\pi} d\theta - \frac{3GM}{c^2 a(a-\varepsilon^2)} \varepsilon \int_0^{2\pi} cos\theta d\theta$$

By doing this integration, we get

$$\delta = \frac{6\pi GM}{c^2 a(1-\varepsilon^2)} \qquad (30)$$

What find the result we get in Eq. (30) is the same result derived by Gerber according to the retarded potential. The difference is that we get the same result by quantization of gravity by considering the quantization of the gravitational potential which is leading to the relativistic effect. We find also according to my equivalence principle and my transformation there is no need to propose dark matter and dark energy where they are explained as the result quantization of gravity. That is how classical physics and Newton's gravity can't explain dark matter or dark energy, and even since general relativity of Einstein is considered as classical, general relativity of Einstein can't explain dark matter and dark energy.

Sagnac effect

Sagnac effect can be explained according to my transformations by considering the t-term in my transformation.

$$t = \gamma^2 \left(t' - \frac{vx'}{c^2} \right)$$

If we considered $t^- = \gamma^2 \left(t' - \frac{vx'}{c^2} \right)$ and $t^+ = \gamma^2 \left(t' + \frac{vx'}{c^2} \right)$, in this case we get

$$\Delta t = \gamma^2 \left(\frac{2x'v}{c^2} \right)$$

And since L is invariant and by considering $x' = L$, then we get

$$\Delta t = \gamma^2 \left(\frac{2Lv}{c^2} \right)$$

This result is exactly the same result which derived by Engelhardt [8] in explaining Sagnac effect in the framework of the ether theory.

And that explains how Schrodinger showed that the emission of a light quantum by a (flying) atom is regulated by the conservation laws of energy and linear momentum. Therefore, the Doppler effect for photons is the consequence of the energy and momentum exchange between the atom and the photon: a central role is played by the quantum energy jump ΔE of the transition (a relativistic invariant) [7].

The Pioneer anomaly

Radio metric data from Pioneer 10/11 indicate an apparent anomalous, constant, acceleration acting on the spacecraft with a magnitude $\sim 8.0\ \times 10^{-10}\text{m}/s^2$, directed towards the Sun [11,12]. Turyshev [13] examined the constancy and direction of the Pioneer anomaly, and concluded that the data a temporally decaying anomalous acceleration $-2 \times 10^{-11}\, m/s^2.yr$ with an over 10% improvement in the residuals compared to a constant acceleration model. Anderson, who is retired from NASA's Jet Propulsion Laboratory (JPL), is that study's first author. He finds, so "it's either new physics or old physics we haven't discovered yet." New physics could be a variation on Newton's laws, whereas an example of as-yet-to-be-discovered old physics would be a cloud of dark matter trapped around the sun. Now I introduce the exact solution for the Pioneer anomaly depending on my transformation and my equivalence principle. and the Hubble's law. According to my solution, there are two terms of decelerations that controls the Pioneer anomaly. The first is produced by moving the Pioneer spacecraft through the gravitational field of the Sun, and this deceleration is responsible for varying behaviour of the Pioneer anomaly in Turyshev [13]. And according to the principle of the quantum superposition in my equivalence we find the second term is depending on the Hubble's law which is equal to the Hubble's constant multiplied by the speed of light in vacuum. This solution of the Pioneer anomaly will give us the origin of the problem of dark matter and dark energy and thus the cosmological constant problem. Sonnleitner [10] showed that how a simple calculation leads to the surprising result that an excited two-level atom moving through a vacuum sees a tiny friction force of first order in v/c. So we find here a connection between what is resulted from this paper and the Pioneer anomaly as a result of quantization of gravity in my theory by the retardation.

We find from Eq. (23) for the free fall object as a result of the vacuum fluctuation, the velocity of the free fall object must be decreased as observed globally. Eq. (23) is working in case of weak and strong gravitational field. This equation can be approximated in case of weak gravitational field as

$$V_{escape-globally} = \left(1 - \frac{2GM}{c^2 r}\right)\sqrt{\frac{2GM}{r}} \qquad (31)$$

Which is the same equation derived from the Schwarzschild Geometry in case of weak gravitational for the free fall object, but according to the Schwarzschild geometry this equation has no any physical meaning, because in reality it is in violation with the equivalence principle of Einstein, and also it is in violation with reality is observer independent according to Minkowski Geometry of space-time.

According to that for low velocities comparing to the speed of light, the difference between the predicted frequency and the reference frequency ν_0 as the result of the red shift is $\Delta\nu_{model}$ given as

$$\frac{\Delta\nu_{model}}{\nu_0} = \frac{V_{escape-locally}}{c} \qquad (32)$$

Now by considering the observed frequency difference $\Delta\nu_{obs}$ is depending on Eq. (31)

$$\frac{\Delta\nu_{obs}}{\nu_0} = \frac{\left(1 - \frac{2GM}{c^2 r}\right) V_{escape-locally}}{c} \tag{33}$$

Where according to my equivalence principle

$$V_{escape-locally} = \sqrt{\frac{2GM}{r} - \frac{G^2 M^2}{c^2 r^2}} \tag{34}$$

Since in weak gravitational field

$$\frac{G^2 M^2}{c^2 r^2} \ll \frac{2GM}{r}$$

Thus in case of weak gravitational field we get

$$V_{escape-locally} = \sqrt{\frac{2GM}{r}}$$

Thus from Eqs. (32)&(33) we get

$$\frac{[\Delta\nu_{obs} - \Delta\nu_{model}]}{\nu_0} = -\left(\frac{2GM}{c^2 r}\right)\frac{\sqrt{\frac{2GM}{r}}}{c} \tag{35}$$

From eq. (35) we get the observed difference frequency is less than the predicted. That means there is a slight blue shift. According to the Pioneer team calculations, the observed, two-way anomalous effect by a DSN antenna can be expressed to first order in V/C as in [1]

$$\frac{[\Delta\nu_{obs} - \Delta\nu_{model}]_{DSN}}{\nu_0} = -\frac{2a'_p t}{c} \tag{36}$$

By DSN convention

$$[\Delta\nu_{obs} - \Delta\nu_{model}]_{usual} = -[\Delta\nu_{obs} - \Delta\nu_{model}]_{DSN}$$

Thus from that and from eq. (35) we get

$$-\left(\frac{2GM}{c^2 r}\right)\frac{\sqrt{\frac{2GM}{r}}}{c} = \frac{2a'_p t}{c} \tag{37}$$

By considering in Eq. (37) $t = \frac{r}{c}$ we get

$$-\left(\frac{2GM}{c^2 r}\right)\frac{\sqrt{\frac{2GM}{r}}}{c} = \frac{2a'_p r}{c^2}$$

And from that we get

$$a'_p = -\frac{GM}{r^2}\frac{\sqrt{\frac{2GM}{r}}}{c}$$

Which is equal to

$$a'_p = -\frac{\sqrt{2}}{rc}(GM/r)^{3/2} \qquad (38)$$

In Eq. (38) we find r represents the distance between the spacecraft and the Sun, and thus we find the deceleration of the spacecraft is depending on the distance of the spacecraft from the Sun.

Now by considering $G = 6.67 \times 10^{-11}\ m^3/kg.s^2, M = 1.99 \times 10^{30}\ kg$ are respectively the gravitational constant and the mass of the Sun. Nasa data [3] show that in the very middle part (1983-1990) of the whole observation period of Pioneer 10, its radial distance from the Sun changes from $r \cong 28.8\ AU = 4.31 \times 10^{12}\ m$ to $r \cong 48.1\ AU = 7.2 \times 10^{12} m$. Thus by computing a'_p from Eq. (38), we get $a'_{p-10} = -1.8 \times 10^{-10}\ m/s^2$ and $a'_{p-10} = -0.52 \times 10^{-10}\ m/s^2$.

Analogous computations for Pioneer 11, as checking point, show the following. Full time of observation of Pioneer 11 is shorter so observational period is taken from 1984 to 1989, with observational data from the same source [3]. Radial distances for beginning and end of the period are $r \cong 15.1\ AU = 2.26 \times 10^{-12} m$, and $r = 25.2\ AU = 3.77 \times 10^{12}\ m$. By using Eq. (38) we get $a'_{p-11} = -9.5 \times 10^{-10}\ m/s^2$ and $a'_{p-11} = -2.62 \times 10^{-10}\ m/s^2$.

We have seen that the deceleration of the pioneer 10/11 anomalies is decreased depending on the distance from the Sun as from Eq. (38), and that what is causing the varying behavior of the Pioneer anomalies according to Turyshev [7]. According to the period of observation 7.5 years from (1983-1990) as noted by Anderson [13], we find for the Pioneer 10 $\dot{a}'_{p-10}$ is given as

$$\dot{a}'_{p-10} = \frac{0.52 \times 10^{-10}\ - 1.8 \times 10^{-10}}{7.5} = -1.8 \times 10^{-11}\ m/s^2.yr$$

Markwardt [14] obtained an improved fit of Pioneer 10 data when estimating a jerk of $\dot{a}'_{p-10} = -1.8 \times 10^{-11}\ m/s^2.yr$ which is exactly same as in my calculations. Also Toth [15] obtained $\dot{a}'_{p-10} = -2.1 \times 10^{-11}\ m/s^2.yr$ which is agreed with my calculations.

Now there is another term must be added to the Pioneer anomaly in Eq. (38) according to the principle of the quantum superposition in my equivalence. This term is related to the Hubble's law. We have from Hubble's this deceleration is given according to the equation

$$a_H = Hc \qquad (39)$$

Where a_H is the deceleration is caused by the Hubble, where is this case since the spacecraft is going far away from the Sun, in this case it observed for an observer on ground, there is a slight blue-shift given according to the Eqs. (38)&(39). If the spacecraft is in a free fall toward the Sun, in this case, it will be observer a slight red-shift which is given also according to Eqs. (38)&(39). According to that we get the full Pioneer anomaly is given according to

$$a_p = -\,Hc - \frac{\sqrt{2}}{rc}(GM/r)^{3/2} \qquad (40)$$

An estimate of the Hubble constant, which used a new infrared camera on the Hubble Space Telescope (HST) to measure the distance and redshift for a collection of astronomical objects, gives a value of H= 73.8 ± 2.4 (km/s)/Mpc or about $H = 73.8 \pm 2.4\ (km/s)/Mpc$ [16,17]. Thus from Eq. (40) we get for the Pioneer 10 at distance $r = 28.8\ AU$ or after 11 years of lunch

$$a_{p-10} = -a_H - a_p' = -7.20 \times 10^{-10} - 1.87 \times 10^{-10} = -9.07 \times 10^{-10}\, m/s^2$$

This quantity is very agreed with the observed Pioneer 10 acceleration (at t=11 years of lunch), in fig. (1) taken from Turyshev [13].

At a distance $r = 48.1\ AU\ at\ t = 18$ years of lunch, we get

$$a_{p-10} = -7.20 \times 10^{-10} - 0.52 \times 10^{-10} = -7.72 \times 10^{-10}\, m/s^2$$

This quantity is agreed with the observed Pioneer 10 acceleration (at t=18 years of lunch), in fig. (2) taken from Turyshev [13].

We find from my transformation by translating the retardation according to the invariance by the entanglement which is leading to the wave-particle duality and the uncertainty principle by the vacuum fluctuation, the gravitational field is expressed according to the energy fluctuation, the vacuum energy fluctuation effectively gives a correct explanation of dark energy and dark matter, where in this case dark matter and dark energy are explained , and that will provide a solution to the cosmological constant problem. Figure (3) illustrates the predicted Pioneer 10 anomaly according to Eq. (40).

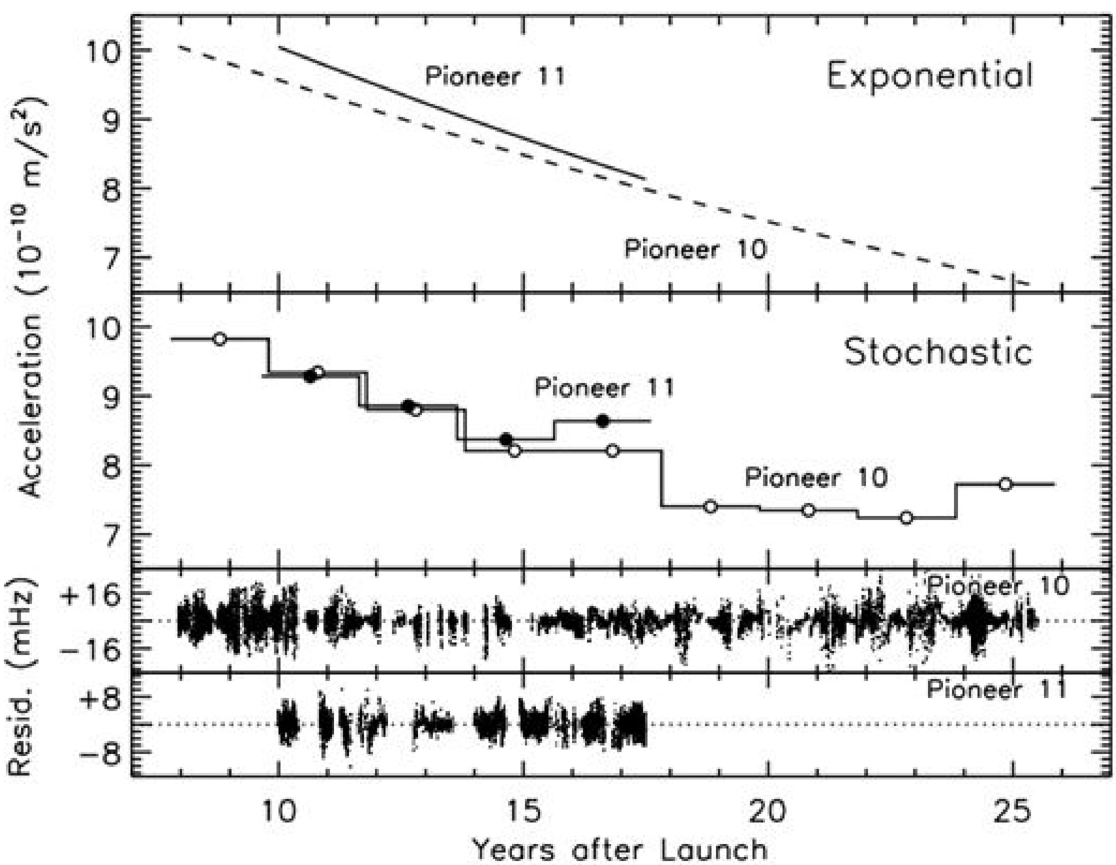

Fig. (2): Top panel: Estimates of the anomalous acceleration of Pioneer 10 (dashed line) and Pioneer 11 (solid line) using an exponential model. Second panel: Stochastic acceleration estimates for Pioneer 10 (open circles) and Pioneer 11 (filled circles), shown as step functions. Bottom two panels: Doppler residuals of the stochastic acceleration model. Note the difference in vertical scale for Pioneer 10 vs. Pioneer 11. Turyshev [13].

$a_{p-10}(\times 10^{-10}\, m/s^2)$, $H = 73.8 \pm 2.4\ (km/s)/Mpc$, $a_p = Hc + \frac{\sqrt{2}}{rc}(GM/r)^{3/2}$

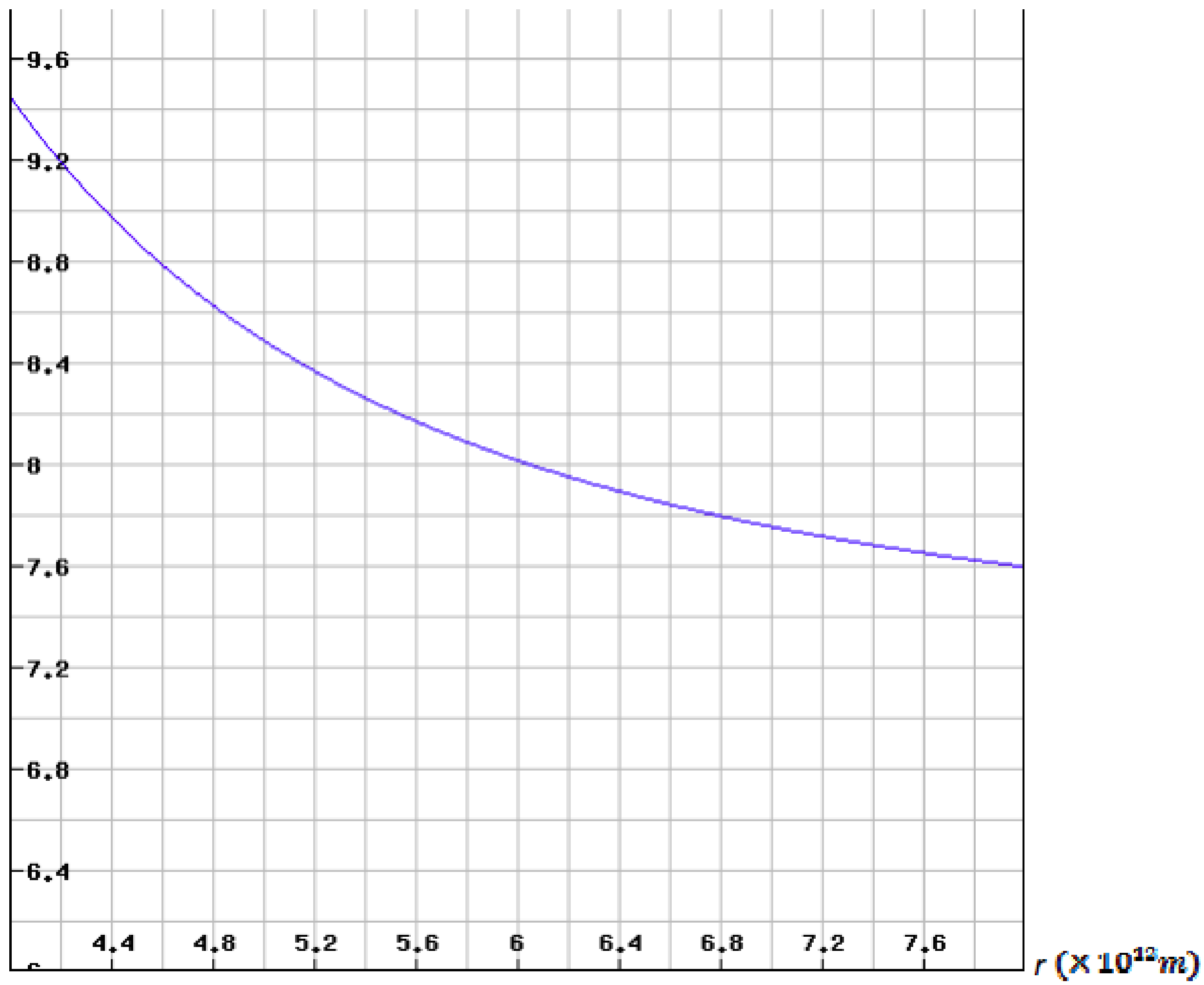

Fig. (3), the predicted Pioneer 10 anomaly versus distance from the Sun according to my solution.

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